Kentucky Erosion Prevention and Sediment Control Field Guide

Kentucky Erosion Prevention and Sediment Control Field Guide

Funding for this project was provided in part by a grant from the U.S. Environmental Protection Agency (USEPA) through the Kentucky Division of Water (KDOW), Nonpoint Source Section and the Kentucky Division of Conservation (KDOC) to Tetra Tech, as authorized by the Clean Water Act Amendments of 1987, Section 319(h) Nonpoint Source Implementation Grant # C9994861-01. Mention of trade names or commercial products, if any, does not constitute endorsement. This document was printed on recycled paper.

Technical Review Committee

Bruce Scott, KY Division of Water
Tom Gabbard, KY Division of Water
Joe Ferguson, KY Division of Water
Jennifer Thompson, KY Division of Conservation
Carolyn Hestand, KY Division of Conservation
David Waldner, KY Transportation Cabinet
Stephen Bowling, KY Transportation Cabinet
Ray Werkmeister, KY Transportation Center
Kurt Mason, USDA NRCS
Charles Farmer, USDA NRCS
Mary Kathryn Dickerson, Boone, Kenton, Campbell Cons. Dist.
David Uckotter, Lexington-Fayette Urban Co. Govt.
Randy Stambaugh, Metropolitan Sewer District
John Lyons, NKY Sanitation District # 1
James Kipp, KY Water Resources Research Institute
Lindell Ormsbee, Tracy Farmer Center for the Environment
Laura Wagers, KY Association of Counties
Henry Duncan, UK Cooperative Extension Service
Richard Warner, UK Cooperative Extension Service
Judy Petersen, KY Waterways Alliance
Russ Barnett, KY Institute for Sustainable Development
Michael Berthurem, KY League of Cities
Juva Sizemore Barber, Home Builders Association of Kentucky
Richard Walker, Tetra Tech
John Kosco, Tetra Tech
William Marshall, Tetra Tech
Barry Tonning, Tetra Tech

This document has been approved by the Kentucky Transportation Cabinet, and reflects Best Management Practices for erosion and sediment control for highway construction projects.

Clean runoff starts with you.

This *Field Guide* will take you through the erosion and sediment control process. The guide starts out with sections on pre-project planning and operational activities. The rest of the guide discusses erosion prevention and sediment control by starting at the top of the hill, above the project site, and proceeding down the slope through the bare soil area, ditches and channels, traps and basins, and on down to the waterways below. The drawing below summarizes this approach.

Preserve existing vegetation

Divert upland runoff around exposed soil

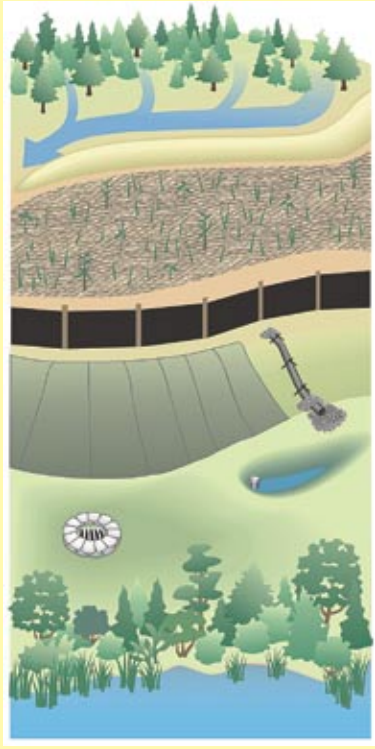
Seed/mulch/ cover bare soil immediately

Use sediment barriers to trap soil in runoff

Protect slopes and channels from gullying

Install sediment traps and settling basins

Preserve vegetation near all waterways



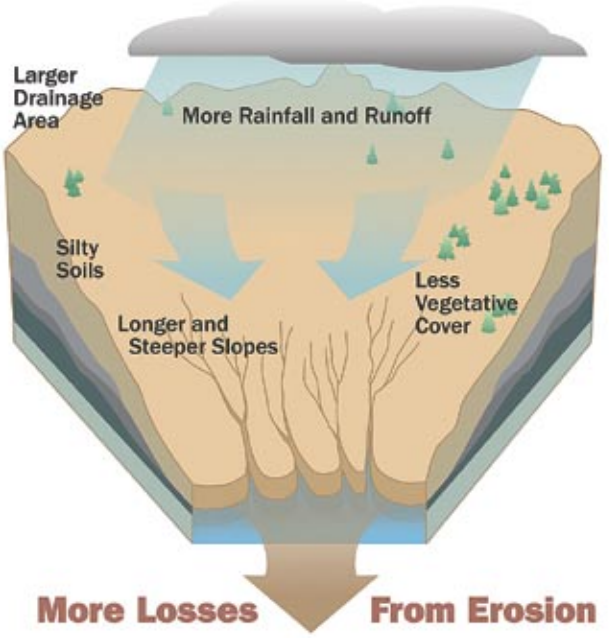
Why do we need to control erosion and sediment losses from construction sites?

Sediment washing into streams is one of the biggest water quality problems in Kentucky. Sediment muddies up the water, kills or weakens fish and other organisms, and ruins wildlife habitat. It is not difficult to reduce erosion and prevent sediment from leaving construction sites. Follow the basic approach shown above. Sites with steep slopes near waterways need more controls than flat sites farther away.

Observe basic principles such as: 1) Preserve existing vegetation as much as possible; 2) Mulch or seed bare soil immediately for the best and cheapest erosion protection; 3) Use silt fences, brush barriers, or other approaches to pond and filter sediment from runoff; 4) Install silt check dams made of rock, brush, or other products to prevent ditch erosion and remove sediment; 5) Protect inlets and outlets; and 6) Settle out soil particles in sediment traps and basins.

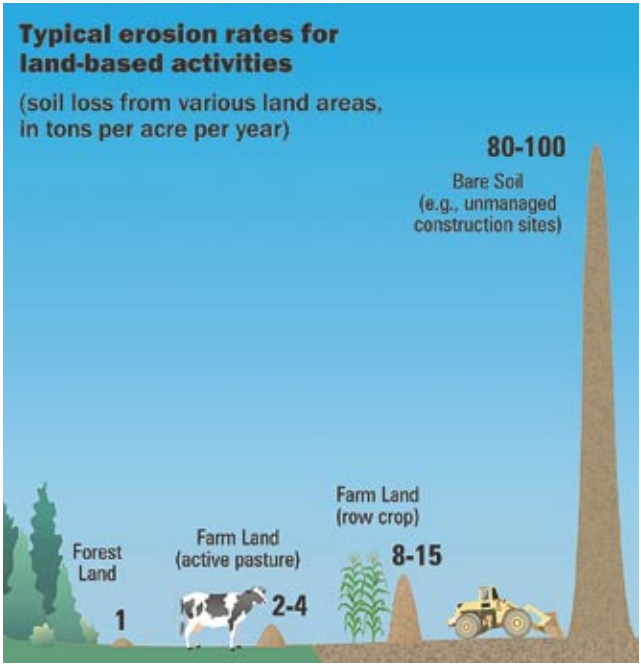
Table of Contents

What contributes to erosion?



Factors influencing erosion. Heavy rainfall, steep slopes, removal of most existing vegetation, and erodible soils result in higher soil losses from erosion.

Lower rainfall amounts, flatter slopes, preserving existing vegetation, and less erodible soils result in lower soil losses from erosion.



What contributes to erosion?

- Removing vegetation
- Removing topsoil and organic matter
- Reshaping the lay of the land
- Exposing subsoil to precipitation
- Failure to cover bare soil areas
- Allowing gullies to form and grow larger
- Removing vegetation along stream banks

What other factors affect erosion?

Rainfall frequency and intensity

Slope (steep = more; flat = less)

Soil structure and type of soil (silty = more erosion)

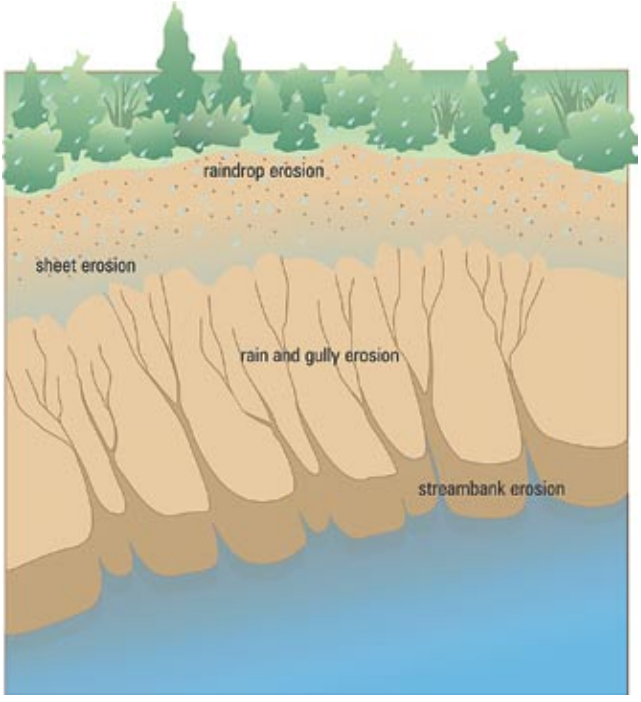
Vegetation (more vegetation = less erosion)

Erosion and sediment controls for muddy runoff:

- Soak it in—maximize seeding and mulching
- Sift it out—use silt fences or other filters
- Slow it down—don't let gullies form
- Spread it around—break up concentrated flows
- Settle it out—use sediment traps and basins

Types of Erosion

Types of erosion. Raindrop erosion (top) breaks down soil structure. Slope runoff creates sheet erosion, which can lead to the formation of small rill channels and larger gullies (below). Erosion of unprotected stream banks can be caused by removing vegetation and higher flows caused by runoff from pavement, sidewalks, and roofs in newly developed areas.



SECTION 1

Pre-Construction Planning

Planning your construction project can help you avoid costly mistakes in controlling erosion and sediment loss to nearby waterways. Follow the steps below before you begin clearing, grading, and excavation work. If your project is one acre or larger, you will need a storm water permit from the Kentucky Division of Water (502-564-3410, or see http://www.water.ky.gov/permitting/wastewaterpermitting/KPDES/storm/).

Assess soils and slopes on the construction site

If your construction site has highly erodible soils and steep slopes, you will need maximum erosion and sediment control protection. See the table below.

Need for erosion and sediment controls for various slope and soil conditions

	Soil Type		
Slope Angle	**Silty**	**Clays**	**Sandy**
Very Steep (2:1 or more)	*Very high*	*High*	*High*
Steep (2:1–4:1)	*Very High*	*High*	*Moderate*
Moderate (5:1–10:1)	*High*	*Moderate*	*Moderate*
Slight (10:1–20:1)	*Moderate*	*Moderate*	*Lower*

Identify nearby streams and drainage control points

Walk over the site and find where ditches or other concentrated flows leave the site. These are the final sediment control points. Sediment traps or basins should be installed just above these control points. Your site may drain to an underground storm sewer system. In this case, the storm drain inlets that drain runoff from your site are the control points and must be protected (see Section 7). These are also the compliance points for any permits issued for the site. Low spots—where rain water ponds—are good places for sediment traps (see Section 9).

Install clean water diversions, sediment traps/basins, grassed ditches, silt check dams, and sediment barriers such as silt fences *before* clearing and excavation work begins!

Preserve existing vegetation wherever possible

Only dig or grade where necessary. Existing trees, bushes, and grass help keep erosion to a minimum. Protect large trees by marking off a no-dig root protection zone that is twice as large as the outer perimeter of the branches. Plan your project to limit the amount of bare soil area exposed to the weather, and limit the amount of exposure time. Do not clear vegetation or excavate areas near streams, rivers, lakes, or wetlands without getting the required state and federal permits!

Design projects to fit the lay of the land

Minimize clearing and grading to preserve mature vegetation and save money. Identify natural landscape features you want to keep, like large trees, wildflower areas, grasslands, streams, and wetlands. Plan ways to fit your project around these features, so they remain in place after construction is completed. Be sure to mark off these areas with colored ribbon or stakes and warn equipment operators of their location!

Minimize impervious surfaces

Keep the amount of roof area, parking lots, driveways, and roads to a minimum. Design these hard surfaces so that rain water they collect is directed onto landscaped or yard areas, not into ditches or streams. For example, design roads slightly higher than adjacent lawn areas, and use rain infiltration ditches (swales) rather than curbs along roadways. Porous pavement can also help soak up runoff.

Promote infiltration in project design

Moving storm water runoff from hard surfaces to landscaped or yard areas helps runoff soak into the soil. This promotes groundwater recharge, filters sediment and other pollutants from runoff, and helps to prevent flooding.

Develop an erosion and sediment control plan

Develop a written site plan for your project that shows the drainage patterns and slopes, areas of disturbance (cuts/fills, grading), location of erosion and sediment controls, location of surface waters and wetlands, and the location of storm water drainage control points. Your site plan must be updated as conditions change at the site. **If your construction site is one acre or more, erosion protection and sediment control plans must be on file to assure compliance with storm water regulations** (see Appendix A). Plans related to state road projects must be filed with the Transportation Cabinet; some counties also require that plans be filed with local agencies (see Section 12 and Appendices).

Design specifications for erosion and sediment controls (i.e., "Best Management Practices" or BMPs) are available from the Kentucky Division of Water, Division of Conservation, the Louisville-Jefferson County Metropolitan Sewer District, and the Lexington-Fayette Urban County Government.

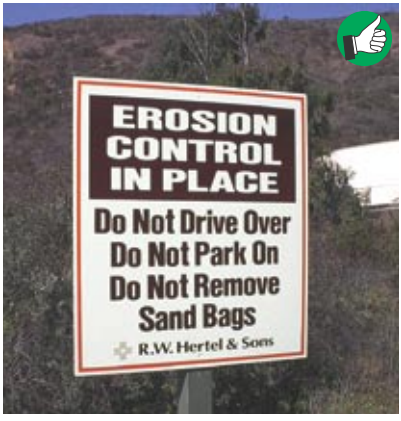
Prioritization of erosion and sediment controls for construction sites

Practice	Cost	Effectiveness
Limiting disturbed areas through **phasing**	$	
Protecting disturbed areas through **mulching and revegetation**	$ $	
Installing diversion around disturbed areas.	$ $ $	
Sediment removal through **detention** of all site drainage	$ $ $ $	
Other **structural controls** to treat sediment-laden flow	$ $ $ $ $	

The cheapest erosion and sediment controls are the most effective. For example, limiting the amount of bare soil by phasing your project and preserving existing vegetation are less expensive and work better than installing large storm water control basins or ponds.

Limiting the amount of bare soil exposed to the weather by working in phases reduces erosion and sediment control expenses.

Preserving existing vegetation at the site makes the final development more attractive and saves money by reducing clearing, excavation, and erosion control expenses.



Erosion and sediment controls are required for all construction sites one acre or larger under new federal, state, and local regulations. Storm water pollution prevention plans (also called Best Management Practice Plans) must be written up before the project begins. Permit coverage is also required before clearing, grading, or other cut/fill activities start.

Storm water pollution prevention (BMP) plans and KPDES permit coverage are required for all construction sites one acre or larger under 2003 regulations. Plans must be kept on site and available for inspection.

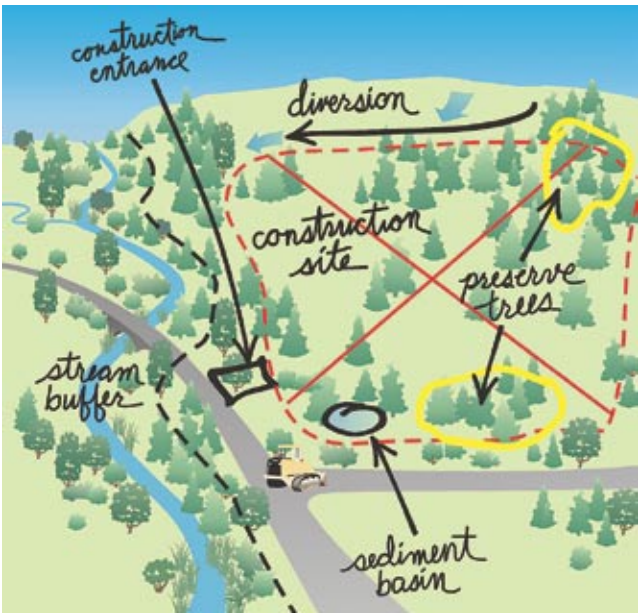
Providing primary and secondary containment for fuel and other hazardous materials at the work site helps prevent problems. Controlling non-storm water runoff, trash and other wastes, and post-construction runoff are also required under the new storm water permit program.

SECTION 2

Construction Phase Operations

Divide your construction site into natural drainage areas, so you can deal with each one individually. You will be controlling erosion on bare soil areas by applying seed, mulch, or sediment filters, and minimizing the time bare soil is exposed to the weather. Control points for sediment in runoff will be at the curb inlets or in the ditches, channels, or sediment traps/basins installed where concentrated flow leaves the site.

Install clean water diversions, sediment traps/basins and stabilize drainage channels with grass, liners, and silt check dams *before* excavation, fill, or grading work begins (see Sections 8 and 9). Install silt fences and other sediment barriers downhill from bare soil areas before clearing or excavation work begins (see Section 5).



Identify drainage areas and drainage ditches and channels. Install diversions, grassed channels, sediment traps/basins, downslope sediment barriers, and rock construction entrance before beginning work.

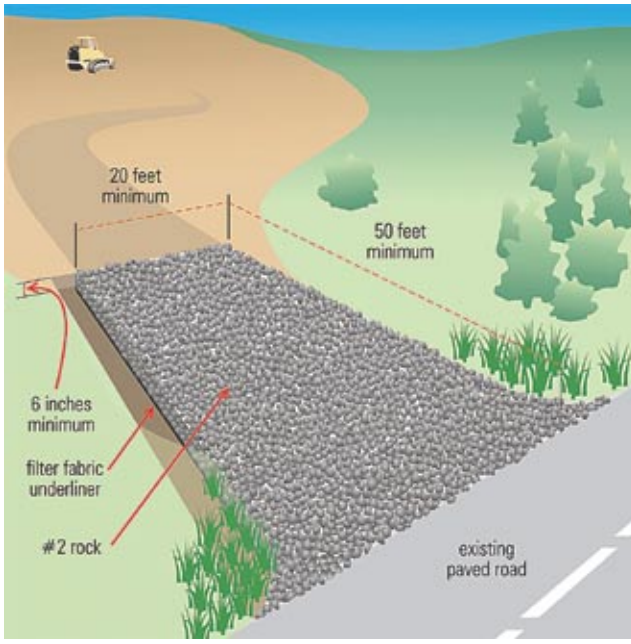
Phase your construction work to minimize exposed soil areas

Excavate or place fill material at the site in stages, to avoid exposing large areas of bare soil to the elements. Establish final grade quickly, then seed, mulch, or cover bare soil. Require utilities and sub-

contractors to grade their work sites and seed, mulch, or cover excavated areas promptly. You should require subcontractors to sign a form assuring compliance with your erosion and sediment control plan if their work is covered under your permit.

If work will proceed over several weeks or months, apply temporary seeding or mulch until final grade work is completed. **New regulations require seeding or mulching all bare soil areas that are not being worked after 21 consecutive days.**

Excavation and grading work should be done during dry weather if possible. Prepare for rainy weather forecasts by making sure sediment controls are in place and that mulch or grass is on bare areas that are at final grade.



Construction entrance detail. Entrance/exit pad must keep mud from tracking onto paved roads.

Install construction entrances and control dust

Mud tracked onto paved roads is the number one complaint from citizens regarding construction site operations. Use #2 (4- to 8-inch) rock—not 57s or 410 "traffic bound"—for entrance/exit pads leading to paved roads. Pads should be 20 feet wide, 50 feet long, and 6" thick. Install filter fabric under the rock to keep it from sinking into the soil below. Rake rock

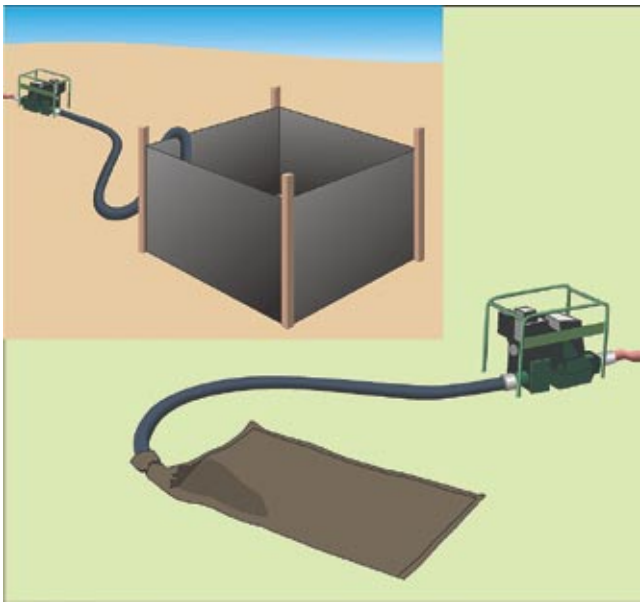
with a grubbing attachment or add new rock if the pad fills with sediment.

Control dust during hot, dry weather by seeding or mulching bare areas promptly, wetting haul roads as needed, or applying approved chemical soil binders.

Dewatering operations and discharges

Muddy water pumped from collection basins or other areas must not be pumped into storm sewers, streams, lakes, or wetlands unless sediment is removed prior to discharge. **Discharges to streams, lakes, or wetlands, or storm sewers must be covered by a KPDES permit issued by the Division of Water.**

Use sock filters or sediment filter bags on discharge pipes, discharge muddy water into silt fence enclosures installed in vegetated areas away from waterways, or discharge muddy water into a de-silting basin. Remove accumulated sediment after water has dispersed and stabilize or seed the discharge area. Dispose of sediment in areas where it won't wash into waterways, then grade the area and seed.



Pump muddy water from dewatering operations away from waterways into a silt fence enclosure or use a bag filter or other device to remove sediment. Allow discharge to soak into the ground if possible. Do not pump discharger from dewatering operations into curb inlets, storm sewers, creeks, lakes, or rivers without a KPDES permit from the Division of Water.

Inspection and maintenance of erosion and sediment controls

For sites one acre or larger, new state and federal regulations require that you inspect and repair/replace silt fences, vegetated buffers, berms, silt check dams, channels, and other erosion and sediment controls every 7 days and after each rainfall of 0.5 inch or more (0.1 inch for KYTC projects). Remove accumulated sediment from behind silt fences before it reaches ½ the silt fence height. Remove sediment from pipe or curb inlet ponding dams or filters as it accumulates. Clean mud off paved roads immediately. Your inspection reports must be in writing, and kept on file at the site.

Silt check dams in ditches and sediment traps/basins also require periodic sediment removal. Remove sediment from traps and basins before they are halfway full. Dispose of removed sediment in areas where it will not wash into waterways. Seed or mulch bare soil areas as soon as possible.

Keep written records of these inspections, including dates, observations and corrective actions taken, with your erosion and sediment control plan and *Storm Water Pollution Prevention Plan, or BMP Plan*. See Section 5 for information on installing and maintaining overland sheet flow sediment filters. See Sections 7, 8, and 9 for information on handling concentrated flows in ditches, channels, and other areas.

Rock pad was installed properly with right sized rock, but lack of filter fabric underliner is causing rock to spread and sink into the soil. Note tracking of mud onto paved road. Mud tracked on roadways violates BMP standards, and is a potential legal liability.

Rock sizing, placement, and pad sizing are good, but sediment from unprotected slopes and ditches is washing onto paved highway. Serious liability issue.

Poor construction entrance. Rock pad is poorly constructed; rock is too small. Use filter fabric under rock and larger sized rock, such as #2. No mud should be tracked onto paved roads open for traffic.

Rock sizing and placement look OK for a residential site, and very little mud appears on the pavement. The pad is a little thin, however, and it looks like some drivers are not using it—note track marks near curb. Entire area needs seed and mulch.

SECTION 3

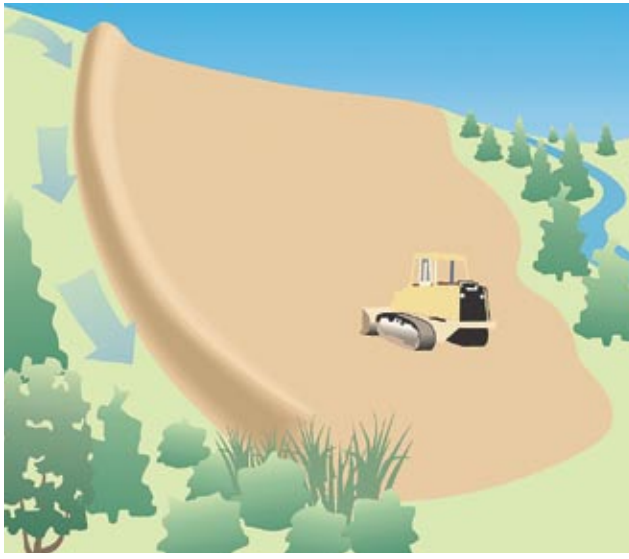
Diverting Upland Runoff Around Exposed Soils

Keep clean upland runoff from flowing through your construction site, or route it through stable ditches so it won't get muddy. Below are some simple approaches for dealing with uphill sources of runoff.

Diversion berms

A diversion berm is a long, mounded "collar" of compacted soil located uphill from the excavated area. The berm is designed to intercept overland runoff and direct it around the construction site. This prevents "clean" water from becoming muddied with soil from the construction site. Berms can be temporary or permanent landscape features of the site.

Berms should be located so that storm water flowing along their uphill face follows a gently sloping path (i.e., less than 5 percent channel slope). Turf reinforcement mats, erosion control blankets, or rock protection might be needed for berms that channel water at a slope of 5 percent or more (see Section 4). Berm side slopes should be 2:1 or flatter, 10 to 14 inches high, and seeded immediately after construction.



Berms and ditches diverting clean upland runoff around construction sites reduce erosion and sedimentation problems. Seed berms and ditches after construction.

Extend the downhill end of the berm so it directs overland flow to areas of thick vegetation or flat surfaces to promote dispersal and infiltration. Seed and mulch berms after construction to minimize erosion.

Diversion ditches

Diversion ditches are similar to berms—they are designed to intercept and divert upland runoff around bare soil areas. Ditches are cut above cleared or fill areas and designed with a gentle slope to carry water away from work areas. Ditches should be 8 to 12 inches deep and seeded. Side slopes should be 2:1 or flatter.

Stabilized, lined ditches can also be used to move upland water through your site without getting muddy. Construct and line "pass-through" ditches before general clearing or grading work begins.

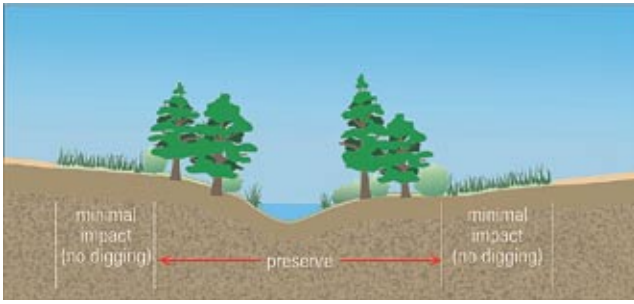
Ditches should discharge to areas with thick vegetation or flat surfaces to promote dispersal and infiltration. Gullies must be repaired as soon as they appear. Ditches with slopes less than 5 percent may be heavily seeded, mulched, and maintained without additional protection if stabilized quickly after construction. Ditches with slopes of 5 percent or more need erosion control blankets, turf mats, or rock liner protection.

Diversion ditches should be lined with grass at a minimum, and blankets if slopes exceed 10:1 (10%) (see Section 8).

Vegetated buffers

Grass, shrubs, trees, and other vegetation located above or below excavated areas should be preserved if possible. Vegetation above construction sites prevents high volume sheet runoff flows from moving across cut or fill areas. Vegetation below the construction site helps filter and trap sediment before it can move into ditches, channels, and streams. All vegetated areas help to promote infiltration of storm water, which is a key objective in preventing erosion and controlling sediment movement off the construction site. Vegetated buffers along channels, streams, and other waterways must not be cleared unless proper permit coverage is provided by KDOW.

Vegetated buffers above or below your work site are always a plus. They trap sediment before it can wash into waterways, and prevent bank erosion.



Vegetated waterways help move upland water through or past your site while keeping it clear of mud. Do not disturb existing vegetation along banks, and leave a buffer of tall grass and shrubs between stream bank trees and disturbed areas.

Good construction, seeding, and stabilization of diversion berm. Note that diversion ditch is lined with grass on flatter part of slope, and with rock on steeper part.

Good installation of rock-lined berm to divert rain runoff around residential construction site on steep slope near a river. Diversion ditches can be lined with grass if channel slopes are 20:1 or less, and with blankets or turf mats if they are steeper.

Well built vegetated berm diverting runoff from wooded stream. Diversion berms and ditches should be seeded after construction. Use blankets if slopes are steep.

SECTION 4

Protecting Soils With Seed, Mulch, or Other Products

Seeding or covering bare soil with mulch, blankets, mats, or other products as soon as possible is the cheapest and best way to prevent erosion. **Grass seeding alone can reduce erosion by more than 90 percent.** Sod, mulch, blankets, and other products can further increase protection (see tables below).

Soil cover requirements

Bare soil in excavated or fill areas must be seeded, mulched, or covered immediately after final grading work is completed. Stockpile topsoil and spread over site prior to seeding. **Bare soil areas must be seeded, mulched, or covered after 14 days** when temporary or final grade is established if no work is planned in that area during the following 7 days (i.e., 21 consecutive days). This requirement can be extended if snow or freezing conditions prevent site work. Seed or cover soil stockpiles if they will not be used for more than 21 consecutive days.

Soil cover vs. erosion reduction

Soil covering	Erosion reduction
Mulch (hay or straw)	
½ ton per acre	75 percent
1 ton per acre	87 percent
2 tons per acre	98 percent
Grass (seed or sod)	
40 percent cover	90 percent
60 percent cover	96 percent
90 percent cover	99 percent
Bushes and shrubs	
25 percent cover	60 percent
75 percent cover	72 percent
Trees	
25 percent cover	58 percent
75 percent cover	64 percent
Erosion control blankets	95–99 percent

Seed types and application

Prepare bare soil for planting by disking across slopes, scarifying, or tilling if soil has been sealed or crusted over by rain. Seedbed must be dry with loose soil to a depth of 3 to 6 inches.

For slopes steeper than 4:1, walk bulldozer or other tracked vehicle up and down slopes before seeding to create tread-track depressions for catching and holding seed. Mulch slopes after seeding if possible. Cover seed with erosion control blankets or turf mats if slopes are 2:1 or greater.

Fertilize poor soils with 400–800 pounds per acre of 10-10-10 fertilizer. Apply lime at 1 to 2 tons per acre if needed. Disk or harrow fertilizer and lime 2 to 4 inches into soil. Follow the contour (level path) with tractors and other equipment on all slopes if possible.

Check seed bag tags to make sure correct seed is used. Mix seed thoroughly prior to loading seeders. Use the following tables to calculate seed application rates, mixture portions, and soil pH requirements, or use seed mixes approved for your site. Apply seed by hand, seeder, drill, or hydroseed. Drilled seed should be ½ inch deep. Mulch right away if possible.

Apply *more* seed to channels, ditches, lawn, and landscaped areas. Apply less seed to areas that are flat or that will not be mowed very often. Water seeded areas during dry conditions to ensure seed germination and early growth. Re-seed areas that do not show growth within 14 days after rain or watering.

Kentucky Transportation Cabinet seed mixes

Mixture Type	Percentage	Seed Type
Mixture No. I	75%	Kentucky 31 Tall Fescue
	10%	Red Top
	5%	White Dutch Clover
	10%	Ryegrass (perennial)
Mixture No. III	30%	Kentucky 31 Tall Fescue
	15%	Red Top
	15%	Partridge Pea
	20%	Sericea Lespedeza
	10%	Sweet Clover – Yellow
	10%	Ryegrass

Protect bare areas during the cold season by sowing winter rye, winter wheat, or mulching. Sow permanent seed when weather permits.

Do not mow newly seeded bluegrass or red fescue until it is at least 4 inches high. Crownvetch should never be mowed. KY 31 tall fescue can be mowed for appearance or only occasionally, according to site conditions and the owner's preferences.

Seed mixes for wildflower and native plant plots are also available. They are more expensive, but are very hardy, require little mowing or watering, and add beauty to landscaped and other areas. Most mixes require mowing only once per year, to control tree and brush growth.

Excellent soil preparation prior to seeding. Seeded development sites erode less, are cleaner, and are easier to market than muddy sites.

Erosion and sediment loss is virtually eliminated on seeded areas (left side). Rills and small gullies form quickly on unseeded slopes (right).

Other suggested seeding rates, soil conditions, and other information for various species and seed mixtures				
Seed species & mixtures	**Seeding rate/acre**	**Per 1000 sq. ft.**	**Soil pH**	**Other information**
Seed and seed mixtures for relatively flat or slightly sloping areas				
Perennial ryegrass + tall fescue Tall fescue + ladino or white clover	25 to 35 lbs. 15 to 30 lbs. 40 to 50 lbs. 1 to 2 lbs.	1 lb. 1 lb. 1½ lb. 2 oz.	5.6 to 7.0 5.5 to 7.5	Apply lime at 2 tons per acre if soil pH is below 5.5; use 400-800 lb. fertilizer (10-10-10) on poor soils. Use wildflower or "no mow" mixes to save on mowing and watering costs.
Steep slopes, banks, cuts, and other low maintenance areas (not mowed)				
Smooth bromegrass + red clover Tall fescue + white or ladino clover Orchardgrass + red clover + ladino clover Crownvetch + tall fescue	25 to 35 lbs. 10 to 20 lbs. 40 to 50 lbs. 1 to 2 lbs. 20 to 30 lbs. 10 to 20 lbs. 1 to 2 lbs. 10 to 12 lbs. 20 to 30 lbs.	1 lb. ½ lb. 1 lb. 2 oz. 1 lb. ½ lb. 2 oz. ¼ lb. 1 lb.	5.5 to 7.5 5.5 to 7.5 5.6 to 7.0 5.6 to 7.0	Track steep slopes with dozer up and down hill before seeding. Mulch slopes after seeding with 2 to 3 tons of straw or 6 tons of wood chips per acre. Use tackifier on mulch, disk it in, or punch in with sheep-foot roller. Disk or sheep-foot on the contour (across slope, on the level). For extremely steep slopes, use erosion control blankets after seeding. Use 24" spacing for blanket staples.

Lawns and other high traffic or high maintenance areas (mowed)				
Bluegrass	105 to 140 lbs.	3 lb.	5.5 to 7.0	Use wildflower mixes to save on mowing and watering costs. Do not establish grassed lawns near streams or wetlands – leave a 15- to 30-foot buffer of natural vegetation.
Perennial ryegrass (turf)	45 to 60 lbs.	2 lb.	5.6 to 7.0	
+ bluegrass	70 to 90 lbs.	2½ lb.		
Tall fescue (turf type)	130 to 170 lbs.	4 lb.	5.6 to 7.5	
+ bluegrass	20 to 30 lbs.	1 lb.		
Ditches and other areas of concentrated water flows				
Perennial ryegrass	100 to 150 lbs.	3 lb.	5.6 to 7.0	Seed ditches and channels thickly. Do not use fertilizer near ditch or channel bottom. Use erosion control blankets or turf reinforcement mats when channel bottom slopes exceed 3 percent. Silt check dams are needed when channel slopes exceed 5 percent or when channels begin downcutting (gullying) on the bottom. Do not use silt fencing or hay bales as silt check dams in channels with slopes greater than 3 percent; use rock, brush, or commercial silt dikes instead.
+ white or ladino clover	1 to 2 lbs.	2 oz.		
Kentucky bluegrass	20 lbs.	½ lb.	5.5 to 7.5	
+ smooth bromegrass	10 lbs.	¼ lb.		
+ switchgrass	3 lbs.	2 oz.		
+ timothy	4 lbs.	¼ lb.		
+ perennial ryegrass	10 lbs.	¼ lb.		
+ white or ladino clover	1 to 2 lbs.	2 oz.		
Tall fescue	100 to 150 lbs.	3 lb.	5.5 to 7.5	
+ ladino or white clover	1 to 2 lbs.	2 oz.		
Tall fescue	100 to 150 lbs.	3 lb.	5.5 to 7.5	
+ perennial ryegrass	15 to 20 lbs.	½ lb.		
+ Kentucky bluegrass	15 to 20 lbs.	½ lb.		

Good mix of sod, seed, and mulch at site of new community center. Note that inlet should be protected by installing a rock or sandbag berm to pond water before it flows into the inlet.

Poor seed establishment on slope. Use erosion control blankets or turf reinforcement mats when slopes are steep (greater than 4:1) and soil quality is poor. Terracing or benching steep slopes also helps.

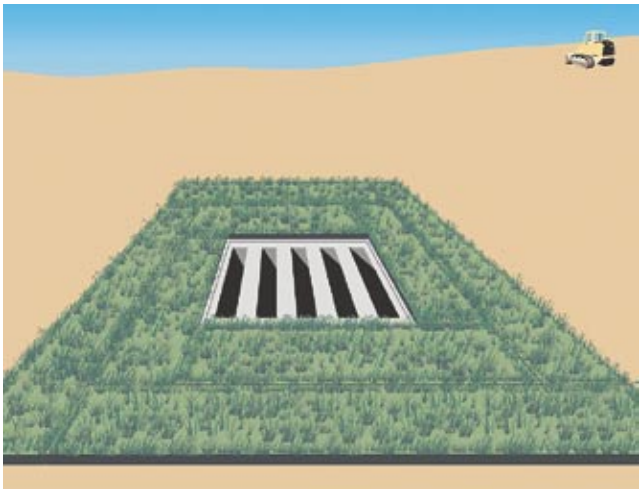
Poor management of bare soil areas on residential construction site. Temporary or permanent seed or mulch must be applied as soon as final grade is achieved.

Sod application

Sod reduces the potential for erosion to near zero. To install, bring soil to final grade and clear of trash, wood, rock, and other debris. Apply topsoil, fertilizer, and lime if needed (approx. 1000 lbs. 10-10-10 fertilizer per acre; 1 to 2 tons of lime per acre).

Use sod within 36 hours of cutting. Lay sod in straight lines. Butt joints tightly, but do not overlap joints or stretch sod. Stagger joints in adjacent rows in a brickwork type pattern. Use torn or uneven pieces on the end of the row. Notch into existing grass.

Anchor sod with pins or stakes if placed on slopes greater than 3:1. Roll or tamp sod after installation and water immediately. Soak to a depth of 4 to 6 inches. Replace sod that grows poorly. Do not cut or lay sod in extremely wet or cold weather. Do not mow regularly until sod is well established.



Sod provides immediate protection around storm drain inlets, on slopes, and other areas.

Mulch types and application

Mulch by itself or applied over seed provides excellent erosion protection (see table). To apply, bring site to final grade and clear rocks, wood, trash, and other debris. Apply seed first. Straw or hay should be hand scattered or blown at a rate of 1½ to 2½ tons per acre (see table). Wood chips, bark, and sawdust should be applied at 5 to 8 tons per acre. Emulsified asphalt or other tackifier should be used on slopes greater than 3:1. In general, apply mulch so that at least 80 to 90 percent of the ground is covered.

Mulch product	Application rate	Benefits	Limitations
Straw or hay	1½ to 2½ tons per acre	Readily available and inexpensive; very effective in controlling erosion; can be applied on large sites via blower	May carry unwanted seeds; may need tackifier or anchoring, especially on steep slopes; crimp mulch in with dozer or straight-set disk harrow to prevent blow-off
Wood chips, bark, sawdust	5 to 8 tons per acre	Very low cost in some locations; can use chips produced from removed vegetation; chips effective on slopes up to 35 percent	High nitrogen demand when decomposing; may float away or blow away during rain storms
Rock	200 to 500 tons or more per acre	May be inexpensive and readily available in some localities; may be suitable for smaller sites	Inhibits plant growth; adds no nutrients to the soil; can be costly to apply on slopes and large sites; adds "hardened" look to slopes
Hydraulic mulches and soil binders	1½ to 2 tons per acre	Easily and rapidly applied with sprayer equipment; can include seed, fertilizer, and soil binders; many new products available	May be too expensive for small or very remote sites; must dry for at least 24 hours before rainfall. See Appendix F for KYTC application limitations.
Compost	2 to 3 tons per acre	Adds nutrients to the soil; readily available and inexpensive in some locations	Limited erosion control effectiveness; not suitable for steep slopes; may be expensive in some areas

Installing sod immediately after grading work is complete can reduce erosion and sediment loss to near zero.

Excellent application of hand-scattered straw mulch in new residential subdivision. Work sites must be seeded and mulched as soon as final grade is established. Crimp mulch into soil with dozer tracking or disk harrows set straight to prevent straw from blowing.

Very good treatment of roadside areas with blown straw after seeding. In areas near lakes, streams, and rivers, straw in roadway must be cleaned up after application.

Excellent soil coverage at stream bank stabilization project using hand scattered straw, jute matting, and erosion blanket.

Good slope protection with permanent rock cover. This slope could have been protected with erosion control blankets or mats and seeded for a "softer" look.

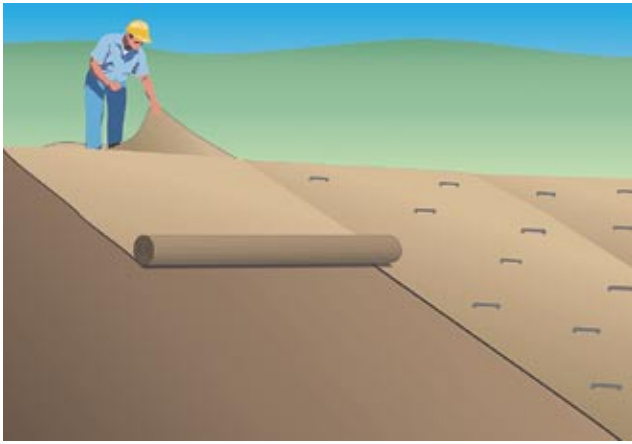
Erosion control blankets

Erosion control blankets are used to protect steep slopes (up to 3:1; check product information sheets), drainage ditches with less than 20:1 slopes, and other areas where erosion potential is high. Most are designed to provide temporary stabilization until vegetation is established. Blankets degrade within 6 to 24 months, depending on their makeup. They usually consist of a layer of straw, coconut fiber, wood fiber, or jute sandwiched between layers of plastic or fiber mesh.

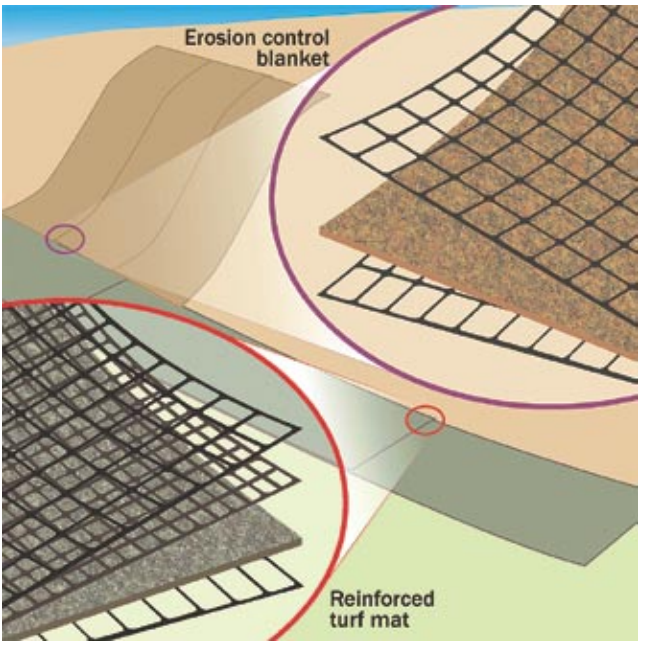
For short slopes (8 feet or less) above channels, install blankets across the slope (horizontal). Install up and down the hill (vertical) for long slopes.

Site conditions	Blanket installation notes
Ditches and channels (from high flow line to ditch bottom—see Section 8)	• Grade, disk, and prepare seedbed. • Seed, lime, and fertilize the area first • Install horizontally (across slope). • Start at ditch bottom. • Staple down blanket center line first. • Staple & bury top in 8" deep trench. • Top staples should be 12" apart. • Uphill layers overlap bottom layers. • Side overlap should be 6"–8". • Side & middle staples = 24" apart. • Staple below the flow level every 12". • Staple thru both blankets at overlaps.
Long slopes, including areas above ditch flow levels	• Grade, disk, and prepare seedbed. • Seed, lime, and fertilize first. • Install vertically (up & down hill). • Unroll from top of hill if possible. • Staple down center line of blanket first. • Staple & bury top in 8" deep trench. • Top staples should be 12" apart. • Side & middle staples = 24" apart. • Uphill layers overlap downhill layers. • Overlaps should be 6"–8". • Staple thru both blankets at overlap.

Walk blankets down to ensure good contact with the soil. Use plenty of staples to keep blankets flat. Overlap blankets at 6 to 8 inches on sides, tops, and bottoms. Do not stretch blankets, and do not exceed manufacturer's directions on maximum slope angle for the product.



Install blankets and mats vertically on long slopes. Unroll from top of hill, staple as you unroll it. Do not stretch blankets.



Erosion control blankets are thinner and usually degrade quicker than turf reinforcement mats. Check manufacturer's product information for degradation rate (life span), slope limitations, and installation. Remember to apply seed, fertilizer, and lime before covering with blankets or mats!

Turf reinforcement mats

Turf reinforcement mats are similar to erosion control blankets, but are thicker and sturdier because they have more layers and sturdier fill material. Mats provide greater protection than blankets because of their heavier construction, and last longer in the field.

Mats are used for steep slopes (3:1 or steeper) and ditches or channels with 15:1 to 10:1 slopes. Mats are installed just like blankets (see previous table). Additional staking or stapling is needed for applications in channels that carry flowing water, and on steep slopes.

Other engineered products are available that are similar to blankets and mats. For example, bonded fiber matrices and other hydraulically applied products contain a mix of soil binders, mulch fibers, and even seed and fertilizer that can provide a stable crust that cements soil particles and prevents erosion. Apply seed prior to hydraulic mats or mulches, if seed is not included in the mix. Consult the manufacturer's installation instructions for product applicability and installation instructions.

Very good installation of erosion control blanket in seeded ditch below well-mulched slope on highway project.

Blankets installed along stream banks or other short slopes can be laid horizontally. Install blankets vertically on longer slopes. Ensure 6 inch minimum overlap.

Excellent slope and bank protection for stream stabilization project. Note that stream bottom is not lined, to preserve rock and gravel habitat.

Good application of erosion control blanket to stabilize shoulder and protect storm drain, but too few staples used along the top edge. Trench in top edge of blanket on steep slopes.